DOCUMENT RESUME

ED 074 444 CS 000 388

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TITLE Current Basic Research in Beginning Reading.
PUB DATE Feb 73
NOTE 20p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, Louisiana, February 25-March 1, 1973)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Beginning Reading; *Decoding (Reading); Orthographic Symbols; Paired Associate Learning; Pattern Recognition; *Phonics; *Reading Instruction; *Reading Research; Teaching Methods
IDENTIFIERS *Phoneme-Grapheme Correspondence

ABSTRACT

This paper reviews some recent research on the component skills necessary to learn to read by phonic techniques. The review is divided into four sections, each relating research on one of the skills necessary for novel word decoding. The four skill areas are: (1) learning invariant grapheme-phoneme correspondences; (2) relating the isolated letter sounds to the same sounds in words; (3) dealing with variant pronunciation of graphemes; and (4) dealing with polysyllabic words on a lexical basis. A five-page bibliography is included. (Author/TO)

Presented at AERA Convention
New Orleans
February 1973

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CURRENT BASIC RESEARCH IN BEGINNING READING

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The purpose of this paper is to review some recent research on the component skills necessary to learn to read by "phonics" techniques. The term "phonics" is a generic term for a number of procedures which make the relationship between written and spoken units explicit. It is not the author's intention to enter into the "great debate" (c.f. Chall, 1967). Most of the research conducted to decide between phonics and other approaches to teaching reading has been of the traditional Method A vs. Method B design. As Venezky (1972) points out, such research has added more to the national debt than to our understanding of the reading process.

If one of the goals of a reading program is to have the child decode novel words then most of the evidence indicates that making the relationships between writing and speech explict is more effective than having the child induce the relationship for himself. In a programmatic research effort, Silberman (1964) first designed a program in which a child was required to induce the pronunciation of novel words made up of components from previously learned words. For example, if the child had learned "pan" and "mat" he was then tested for transfer on "man" and "pat". After the failure of a very extensive try-out of this approach Silberman gave up and trained the children on the initial consonants and final vowel-consonant clusters separately. This latter approach allowed for transfer to novel words at approximately the 75% level. A similar finding was reported by Jeffreys and Samuels (1967) in a small scale experiment involving only limited amounts of training.

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The above experiments are similar to the classic Esper (1925) experiment on rule learning in a miniature linguistic system. Many adults can fairly easily induce rules relating visual and auditory elements (a study by Bishop (1964) showed that 75% could do so). Children apparently cannot make this induction except possibly after very extensive training (c.f. Staats, Brewer and Gross, 1970).

The present authors divide the skills necessary for novel word decoding into several areas. The first area is learning of invariant grapheme-phoneme correspondences. Several writers (c.f. Smith, 1971) have argued that there are so few regular spelling to sound correspondences in English that teaching them is misguided. Actually, with a relatively small number of invariant spelling to sound correspondences quite an extensive kindergarten-first grade vocabularly can be developed (Berdiansky, Cronnell and Koehler, 1969). With the addition of some irregularly spelled function words, which can be learned as sight words, adequate if not overly engrossing stories can be written. (The authors have seen few if any engrossing stories in any beginning readers, regardless of approach. This is probably a function of the limitation of storywriters imagination rather than limitation of vocabulary).

The skills involved in learning invariant grapheme-phoneme correspondences are obviously similar to those involved in any paired-associate learning task. Paired-associate learning has been exhaustively investigated and would imagine that there would be a vast store of principles derived from this research which would be applied to children's learning of these tasks.

With this hope in mind, the present authors surveyed the verbal learning literature for clues to optimizing the paired-associate learning of invariant-grapheme correspondences in children. Several conclusions became

apparent: (a) the performance of college sophomores could not be generalized to performance of young children. (b) most of the research on young children employing picture-picture pairs could not be generalized to grapheme-phoneme associations. (c) Rather than being a simple "level I" skill (c.f. Jensen, 1970), P-A learning of abstract materials like grapheme-phoneme associations is very difficult for pre-reading children. In one study (Marsh & Sherman, 1970), approximately one-third of a sample of kindergarten children failed to learn a 3 item list in 20 trials. In a similar study by Calfee, Venezky & Chapman (1970) learning of a three-item list was at only 60% after 5 trials. (Chance is 33% if responses are available). Some possible areas of difficulty are reviewed below.

Differentiation of Graphemes

This has been identified by Gibson (1965) as one of the major stages in learning to read. Undoubtedly, it is at some point in the child's development, but most of the evidence indicates that it is not an important deficiency in the pre-reading 5 year old. Calfee et al (1970) found that kindergarten children made few errors on matching to sample either upper or lower case letters of the English alphabet, even though the distractors were maximally similar to the sample letter. In Gibson's own research (c.f. Gibson, Osser, Shiff & Smith, 1963) with four-year olds, many Ss were replaced because they made no errors with upper case letters and even with the residual sample many error cells of the confusion matrix were empty. A recent study by the present authors (Marsh, Desberg & Farwell, 1971) found that it made no significant difference in the performance of kindergarten children if the stimuli in a P-A task were pictures of familiar objects or lower-case letters. In a second study by the same investigators there was no significant effect of stimulus similarity of letters on P-A

learning although letter pairs were selected to maximize similarity (e.g. m & n; f & t, etc.). In general, the above research indicates that discrimination of graphemes is not a major problem in kindergarten children. Many children have difficulty with the subset of lower-case letters which differentiated only by spatial orientation (p-q-b-d) (Davison, 1934), but this difficulty can be overcome (Karraker, & Doke, 1970).

When children have to learn to match groups of letters, the difficulty increases dramatically (Calfee, et al, 1970). Most of the error confusions are due to order permutations. It appears that one skill that pre-readers should be trained on is to pay attention to order. In most non-reading perceptual situations neither order or spatial orientation are particularly important factors in recognition. Caldwell & Hall (1969) have presented techniques for training children to pay attention to spatial orientation. Similar techniques would probably be useful in inducing children to pay attention to order.

Gibson, Farber & Shepela (1967) used a learning set procedure to attempt to train children on abstraction of spelling patterns which involve letter order as a relevant factor. They met with little success using purely inductive methods but in later research verbal instruction that order was important produced substantial gains in performance. (Gibson, 1970).

Discrimination of Phonemes

Most phoneme discrimination testing has been done in the context of minimal word pairs using a same difference-technique. The Wepman test is a standard test of this type. The relatively high error rates obtained on tests of this type are apparently a function of the use of same-difference procedures and limited testing. In a study by Rudegaeir & Kamil (1969)

using a matching to sample procedure (A-B-X) with multiple testing sessions the error rates for kindergarten children were low; roughly approximating adult error rates. For a small set of phonemes primarily fricatives (e.g./v/ & /ϴ/,/f/ & /ϴ/) error rates are much higher. However, when phonemes must be discriminated in isolation as required by a phonics reading program, the error rate for some other phonemes (e.g. the nasals /m/,/n/ & /ŋ/) doubles (Marsh & Sherman, 1971).

The conclusions regarding phoneme discrimination roughly parallels those on grapheme discrimination. Children have difficulty with only a small set of phonemes in discrimination tasks. A recent study by Marsh, Desberg & Farwell (1971) found no significant overall effect of phoneme similarly on P-A learning even when phonemes pairs were selected to maximally similar.

Production of Phonemes

According to Templin (1957) almost all three year olds can articulate vowels in words correctly and most four year olds can correctly produce the single consonant phonemes. This conclusion was confirmed by Marsh & Sherman (1971) for phonemes in words in an echoic task.

However, Marsh & Sherman found when production of phonemes in isolation is required the error rates for several phonemes increases fantastically. For example:

Phoneme	Error rate In Isolation	In Words
ŋ	90%	0
l	81%	1%
f	54%	12%
n	38%	2%
m	35%	1%
v	38%	12%
u	35%	2%
ɛ	28%	12%

A number of phonemes which are easy for a child to produce in words are extremely difficult to produce correctly in isolation. This is probably a major problem in any phonics reading program.

Associating Graphemes and Phonemes

Desberg & Marsh (1971) compared five presentation procedures, which have been reported in adult paired-associate literature, in training children on grapheme-phoneme associations. The procedures were: 1) standard anticipation method; 2) the study-test trial method; 3) a prompting method which is roughly an inversion of standard anticipation method and insures no errors will occur. In addition, there were two response contingent methods. 4) a drop-out procedure where items given correctly twice are dropped from the list; and 5) an add-on or cumulative method where items are added to the list when a particular criterion of success on existing items is met.

The only difference we found was that the prompting method was inferior to the other four methods. In the prompting method the child can retrieve the response from short-term memory since he has just heard it and apparently does not store the response in long term memory for retrieval on test trials.

The above experiment gave the Ss only limited training and Atkinson & Paulson, (1962) have reported data which indicate that a response contingent

method although producing inferior performance during training as compared to a response-insensitive method, does produce a 10% gain on a delayed retention test. This effect occurred after a considerable training period (24 days), in a computer-assisted instruction situation.

In another study, Marsh & Desberg, (1971) investigated stimulus and response factors as they affect the difficulty in P-A learning of letter sound pairs. As stated previously, comparison of pictures which graphemes as stimuli showed that stimulus factors were not important but a comparison of picture names with phonemes as responses showed a large effect. Apparently, practically all of the difficulty of grapheme-phoneme learning is located on the response side. This implicates response availability as a major factor in the learning process. Coleman (1970) has reported data on difficulty of learning grapheme-phoneme associations. Apparently ease of production in an echoic task is not predictive of response availability in a P-A task. For example, the Marsh & Sherman (1971) study showed that short vowels are relatively easy to produce but short vowels were the most difficult to learn as responses in the P-A task according to Coleman's data. Overall, the correlation between ease of production and ease of learning in P-A tasks in the two studies was negative although not significantly so. Techniques for increasing response availability have been suggested by Coleman (1970) but no research has been carried out. Although no systematic data exists, it is the author's impression that in learning the alphabet most children start by learning the response set as a serial list with mnemonics such as rhymes (e.g. the ABC song) and only there after undertake the P-A task of associating such graphemes with its name.

Since most kindergarten children already know the alphabet as a serial list, and many children can give the correct letter name to each grapheme it is of some interest to know if this knowledge aids them in reading. Although there is a substantial correlation between letter-name knowledge and reading performance, most evidence both in small scale laboratory experiments (Samuels, 1971) and in large scale classroom experiments (Ohnmacht, 1969) indicates that knowledge of the alphabet does not facilitate learning to read. An additional question is whether or not letter name learning facilitates or interferes with letter sound learning. Some recent data collected by the authors indicate that it has neither effect.

We are therefore in the rather unfortunate position of knowing something about why children have such difficulty in learning letter-sound associations, but not knowing much about how to decrease this difficulty. A recent study by the authors (Marsh & Desberg, 1973) found that although pictures as mediators (e.g. /b/ is first sound in bug accompanied by a picture of a bug) did facilitate learning of the letter sounds this effect promptly disappeared when the picture was removed. This effect is similar to Samuels' (1967) results using pictures as additional cues to word learning.

The second major type of skill needed in a phonics program is the ability to relate the isolated letter sounds to the same sounds in words.

One task for assessing this is to have children detect whether or not an isolated phoneme is contained in a given word. (i.e. which word starts with sound /b/: bat or mat) Calfee et al (1970) reported that performance was at chance in their sample of kindergarten children on this task. Marsh & Mineo (1970) used a learning set procedure and manipulated a large set of variables in a similar task. Learning occurred very slowly over a two-week period. In one group given a grapheme as a visual cue performance was substantial but fell to control group levels when the grapheme was removed. This outcome is in conflict with Russian research which reports that visual cues substantially facilitate performance on tasks of this type even after they are removed (Elkonin, 1963).

A second and more popular task is to have the child recognize phonemically segmented words. Research on this task, commonly called blending, has been reviewed by Desberg (1969).

The study by Marsh & Sherman (1970) suggested that this skill is essential for novel word decoding since they found no direct transfer between insolated grapheme-phoneme pairs and words made up of those pairs. Studies which have successfully produced transfer from isolated letter-sounds to words have included a blending instruction component (Silberman, 1964; Jeffrey & Samuels, 1967). In another study which did not include blending instruction (Calfee et al, 1970) there was no transfer from letter-sounds to words.

As Venezky (1971) points out, not too much is known concerning the blending process. Coleman (1970) reports data rank ordering the difficulty in blending various words and syllables. He reports that vowel-consonant

(VC) words and syllables are significantly easier to blend than consonant-vowel (CV) syllables, and that performance increases as a function of practice even through no specific item is repeated. The seven children in his sample were over 80% correct after 500 presentations. Desberg (1969) reported that stop consonants are more difficult to blend than continuents and that various inter-stimulus intervals greater than zero seem to have no effect. The role of frequency of the target word is unclear; Desberg (1969) found an effect of frequency but Coleman (1970) did not. The difference between stops vs. continuants would be expected since stops cannot be produced in isolation but must be followed by a vowel sound (usually a reduced schwa) while continuants do not have this limitation. Thus the child has an extraneous sound to eliminate when blending stops but not continuants.

Thus again we know something about the factors effecting the child's ability to recognize isolated phonemes in a word context but little about how to improve this ability. In an unpublished study Desberg, Marsh & Givendo,(1973) it was found that instruction on blending compound words (tooth-brush) and syllables (ba-by) although considerably easier than blending phonemes (a-t), did not transfer significantly to the latter task.

A third skill needed by the child is the ability to deal with variant pronunciation of graphemes.

There has been some research on the problem of whether or not the child should be taught alternative pronunciations for various graphemes either successively or concurrently (Levin & Watson, 1963; Williams, 1968). These studies suggest that the concurrent method is superior but the effects were small and the problem needs further investigation.

Many variant pronunciations of graphemes are predictable from the intra-word environment. Venezky (1970) has formulated the rules involved. The entire set of rules is somewhat large even for a restricted kindergarten vocabulary (Berdiansky, Cronnel & Koehler, 1969), but some of the rules are generalizable to enough words to be useful. These include the rules governing pronunciation of C (and possibly G) and long vowel-short vowel rules. (See handout). Venezky (1972) reviews research on children and adults knowledge of these rules as evidenced by their pronunciation of nonsense words. These studies indicate that there is a sharp increase in knowledge of these rules between the second and fourth grades but even sixth grade children do not respond consistently in accordance with the rules.

To the authors' knowledge, there has been only one attempt to teach one of these rules to pre-reading children. This attempt (again reported by Calfee et al, 1970) was not successful but the amount of training was very limited. It is apparent that research on this skill has barely started.

Other sets of rules such as morphophonemic rules governing inflectional endings are already in the speech repertoire of the pre-reading child (Berko, 1958). If they are taught to the child in a manner

which makes their function clear the child will probably automatically make the transfer to reading. Graphemes marking inflectional endings such as s, ed, ing and so on should probably be taught as units in context (Marsh, 1970). Gibson & Guinet (1971) have found that such inflectional endings tend to be perceived as units even by third graders.

The fourth skill is dealing with polysyllabic words on a lexical basis.

Chomsky & Halle (1968) have pointed out how the traditional orthography reflects the underlying morphophonemic competance of the adult reader. In reading such polysyllabic words as sane-sanity; penal-penality; crime-criminal, reduce-reduction, the alternation between the long vowel-short vowel contrast is made automatically by adults and presumably by older children. The unchanged orthography reflects the lexical relationship between the words.

The problem with this approach for the beginning reader is twofold: (a) the polysyllabic Latinate words which exhibit such contrasts are not likely to be in the beginning reader's vocabulary (c.f. Wordhaugh, 1971), and (b) according to Chomsky & Halle (1968) the phonemic system is a subsystem under the control of syntactic system. They assume that the reader must be able to interpret the message at the syntactic level prior to being able to assign a phonological interpretation. Chomsky & Halle's (1968) theory is generally concerned with speech, not reading. If applied to reading, it would assume that the same units normally involved in processing speech should be used in teaching reading. This would be at the phrase level at the minimum. Carol Chomsky (1970) has discussed some of the implications of this view for reading.

A great deal of research indicates that the older child is processing written passages at the syntactic level (c.f. Goodman 1968) and Chomsky's (1970) recommendations seems feasible with older children but no research has been done.

Summary

The preceding discussion assumes that skills are involved in beginning reading are different from those involved in the rapid skilled reading of the adult (Weiner & Croner 1967). This assumption has been forcefully questioned (Kolers, 1971; Smith, 1972).

Unfortunately, those who question a phonics approach have not spelled out in detail alternative programs for teaching reading. Until they do so, phonics approaches will probably remain the "conventional wisdom."

A final word concerning the general problems of reading research.

The present authors agree with Venezky (1971) that the Method A vs. Method B type of applied research is generally unfruitful. On the other hand, Venezky is also critical of small scale laboratory research (with a small sample, relatively small amounts of training, etc.). The present authors would agree if such research is seen as generating hypothesis which may be tried out in the classroom. The problems of the external validity of such research are twofold, corresponding to Type I and Type II errors in statistics.

The "Type I" error is well recognized. A treatment different found in a controlled laboratory experiment may wash out when tested in the "real world" of the classroom and statistical significance may not mean practical significance.

The"Type II" error is not so commonly recognized and is harder to deal with. This is when treatment differences which are non-significant or marginal in laboratory experiments turn out to be of both statistical and practical significance when tried out on a large sample over a long period of time. One such example is the present paper was use of response-sensitive procedures which were non-significant in a small scale laboratory experiment but proved to be of practical significance when tried out on a larger sample given a greater amount of training. Many of the hypotheses reported in this paper which have been found wanting in small scale experiments have probably been so because of the limited amount of training and control over motivation, etc. involved in such situations.

Unfortunately, large scale classroom experiments are difficult and expensive to do and often regress back to the Method A vs. Method B design,*. We agree with Venezky's call for an "experimental pedagogy" but its implementation is very difficult given the vested interest that most institutions have in their present programs.

* Method A vs. Method B research is often done by those with an axe to grind. (i.e. developers of a new program who wish to "prove" its superiority to existing programs.)

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